L19: Entry 14 of 32 File: USPT Feb 24, 1998

DOCUMENT-IDENTIFIER: US 5721646 A
**** See image for Certificate of Correction ****
TITLE: Exterior rearview mirror for vehicles

Brief Summary Text (5):
In view of the greater vibration encountered with exterior rearview mirrors in larger vehicles, such as heavy trucks and semis, many prior known rearview mirror assemblies have proven to allow unsatisfactory levels of vibration. For example, many prior known exterior truck mirror assemblies have insufficient structural rigidity to resist vibration, or were constructed with centers of gravity displaced from the axis of support tending to accentuate any encountered vibration and road shocks. In addition, many current truck mirror assemblies have tended to be heavy which further accentuates the vibration encountered in heavy trucks. In addition, many of the prior known rearview mirror assemblies have incorporated non-aerodynamic designs in which the reflective mirror elements visible to the driver are mounted flush with the edge of the mirror housing. These designs suffered from severe wind buffeting and buildup of mist and dirt on the mirror viewing surface such that the driver's ability to view objects in the mirror was significantly reduced. When coupled with the increased vibration present in such assemblies, overall visibility with such mirror assemblies was inadequate.

Brief Summary Text (11):
Various embodiments of the exterior rearview minor assembly may include a single, planar reflective mirror element preferably adjustably mounted on the support bracket to allow movement to various viewing positions. In a preferred embodiment, the mirror mount is an electric actuator which is controllable from a remote location, such as the truck cab, by a driver or passenger in the vehicle, to change the mirror element viewing position. The mirror element together with a support plate are releasably secured to the actuator at the center of gravity of the mirror element by a rotatable, bayonet mounting and latch assembly. Thus, the mirror element is easily field replaceable for service and repair, which also allows access to the actuator for service or replacement. Preferably, each end of the support bracket includes a mounting stud which extends through the housing for attachment to a suitable support arm or arms mounted on the vehicle. The mounting studs are preferably aligned on a common axis to allow fixed positioning or pivotal movement of the entire assembly, depending on the type of support arms used.

Brief Summary Text (12):
The support bracket of the present invention preferably includes a plurality of braces extending between the support members, which braces are spaced from one another and define openings therebetween. Preferably, a series of pairs of such braces are provided with the braces in each pair intersecting in an X-shaped pattern. Additional braces may optionally extend between the points of intersection. The support bracket provides increased torsional and linear stiffness and rigidity to reduce vibration in the overall mirror assembly, and is also curved to position the center of gravity of the assembly as close as possible to the support axis.

Brief Summary Text (17):
Accordingly, the present invention provides an exterior rearview mirror assembly for vehicles including trucks, vans and the like, which has reduced vibration, increased stability and reduced weight to provide clearer viewing images for the vehicle driver. The assembly includes a unique support bracket which spans the interior of the mirror

housing and supports the mirror elements on adjustable mounts, the support bracket being spaced from the housing walls and having support members and interconnecting braces and an optional stiffness improving wall to increase torsional and linear rigidity, and the natural frequency of the support bracket. In addition, the bracket positions the center of gravity of the mirror and mirror mounts as closely as possible to the axis of support of the assembly to further reduce vibrations. Mirror wobble is also reduced by centering the mirror element center of gravity on each actuator. The mirror assembly provides several variations to match the features desired by the vehicle driver including one or two mirror elements, electrical actuation of each mirror element from a remote location, planar or convex viewing surfaces, an electro-optic mirror element for reduced glare, heating elements to prevent ice and snow buildup, and an aerodynamic housing design to reduce the buildup of mist and dirt on the viewing surface.

Detailed Description Text (2):
Referring now to the drawings in greater detail, FIGS. 1-10 illustrate a first embodiment 10 of the exterior rearview mirror assembly of the present invention which is especially adapted for use on large vehicles, such as heavy trucks, vans, recreational vehicles and the like. Assembly 10 includes a reflective mirror element 12, resistive heating element 14 applied to the rear surface of mirror element 12, mirror mount/actuator 16, support bracket 18, and a one-piece, aerodynamically designed housing or shell 20 supported by bracket 18. As shown in FIGS. 3 and 4, mirror mount 16 is adapted to provide adjustable movement of mirror element 12 to various viewing positions about horizontal and vertical adjustment axes, preferably by remote control from the vehicle cab or passenger compartment when the actuator is electrically operated. Support bracket 18 spans the interior space of the mirror housing from adjacent one end to adjacent the opposite end and supports mount/actuator 16 to reduce vibration and weight and increase stability of the overall assembly, as will be more fully explained below.

Detailed Description Text (3):
As shown in FIGS. 1-4, mirror element 12 is a rectangular sheet or panel of glass having rounded comers, preferably having a thickness of 0.063-0.125 inches. A reflective coating 22 of a conventional chrome alloy or other metals or materials is applied by conventional coating methods to the front or first surface of mirror element 12, preferably providing reflection of at least about 55 percent of the light incident thereon. A resistive heating element or pad 14 having a rectangular configuration is preferably adhered to the rear surface of mirror element 12 with a suitable adhesive or tape. Preferably, heater pad 14 is an electrical resistance type element having a grid pattern of conductive ink applied to a mylar carrier substrate and is available from ITW Chronomatic of Chicago, Ill. When electrical voltage is applied by means of wires connected to the heater element and a power source in the vehicle, heater pad 14 provides increased temperature which is conducted through the mirror element 12 to melt ice or snow which may have collected on the first or exposed surface of the mirror element.

Detailed Description Text (5):
Mirror mount 16 is preferably an electrically-operated, adjustable mounting assembly or actuator of the type sold under Model No. 530 by IKU USA, Inc. of Three Rivers, Mich. Electrical actuator 16 is of the type disclosed in U.S. Pat. Nos. 4,101,206 and/or 4,116,538, the disclosures of which are hereby incorporated by reference herein. Alternately, actuator 16 could be of the type disclosed in U.S. Pat. No. 4,281,899, the disclosure of which is also incorporated by referenced herein. Actuator 16 provides adjustment of the supported mirror element about two perpendicular axes, namely, a horizontal and vertical axis, for example, and includes a pair of electric motors 16a, 16b and rack and pinion gearing for movement of an actuator member to which support plate 24 is connected. Of course, other suitable electrically operated or manually operated adjustable mirror mounts could be used to support the mirror element 12, any heater pad 14 and support plate 24 on support bracket 18, as desired. As is shown in FIG. 3, actuator 16 is connected to a source of electrical power in the vehicle by means of a power cord 32 including a wire harness having wires 34 which extend through a strain relief grommet 36 and include releasable blade-type connectors 38 enabling the actuator to be easily disconnected for repair or replacement. Optionally, a manually adjustable, pivotal mirror mount may be substituted for actuator 16.

Detailed Description Text (6):
Mirror support bracket 18 is an elongated, truss-type bracket, preferably sand or die cast from a lightweight metal or metal alloy, such as 319, 356 or 380 aluminum alloy or magnesium, and electrostatically powder painted to provide increased stiffness and rigidity with reduced weight. Bracket 18 includes elongated, generally parallel side members 40 which extend the entire length of the bracket and curve into forwardly extending ends 42. Support members 40 are interconnected by a series of braces 44 which, in the preferred embodiment, form an X pattern which extends along the length of the bracket. Thus, braces 44 are formed in pairs 44a, 44b, 44c, 44d, 44e and 44f in which the braces intersect one another as well as joining the side members and define openings 46 therebetween. If desired, additional brace members 48 may be provided between the points of intersection of braces 44 such that they extend along the elongated axis of bracket 16 across the openings 46 between the points of intersection of braces 44. Braces 48 generally extend parallel to support members 40. If desired, additional cross braces 50 may be positioned to extend generally perpendicular to support members 40 and to intersect braces 48. At the approximate center of bracket 16 is a series of three upstanding securing posts 52 interconnected by walls 54. Posts 52 receive securing screws 56 which extend through actuator 16 to fasten the actuator to the support bracket (FIG. 2).

Detailed Description Text (9):
As constructed, support bracket 18 reduces vibration of the reflective minor element 12 due to the orientation of the X pattern braces 44a-44f, which orientation reduces both linear and torsional vibration. The additional braces 48, 50 and the dimensions of both the support members and braces, as explained above, coupled with the openings between the braces provide increased stiffness and rigidity and reduced weight and mass for the bracket over prior known mirror supports, as well as an increased the natural frequency for the mirror support bracket. Through the use of lightweight sand or die cast metal alloys, such as aluminum or magnesium, the mass to stiffness ratio is reduced. Further, the curved configuration of the support bracket having ends which curve forwardly to provide a support axis extending through fastener posts 64, together with the support of the actuator 16 and mirror elements 12 on the side of the support bracket toward the mirror element substantially aligns the center of gravity of these elements with the pivot axis of the mirror assembly. Coupled with the use of thinner glass for the mirror element these features provide reduced vibration in the mirror assembly as well as avoidance of resonance when the assembly is mounted on appropriate support arms or brackets on the truck or other vehicle.

Detailed Description Text (10):
As is best seen in FIGS. 2, 3, 4 and 7, mirror housing 20 is a relatively thin, one piece shell including a rear wall 70, opposing and top and bottom end walls 72, 74 and opposing side walls 76, 78. The end and side walls define a peripheral rim 80 lying in a defined plane, rim 80 being preferably covered with an extruded, resinous plastic edge trim 81 which can include a desired color to match the housing. Optionally, trim 81 may include a chrome coated mylar film. Preferably, housing 20 is vacuum formed from plateable grade ABS sheet plastic, is colored black or another desired color, or may be covered with a chrome layer. Each end 72, 74 includes a through aperture 82, 84 (FIG. 7) into which boss 60 on the outer surface of the end flange of bracket 18 projects. Thus, when a cortically headed, threaded screw 64 is passed through each aperture 62 in the bracket, fastener posts or studs are provided which extend through apertures 82, 84 on a common axis generally parallel to the plane of rim 80 to provide a mounting or pivot axis for the entire assembly. Housing 20 is then secured on opposite sides of aperture 62 to end flanges 42 by means of a pair of screws 86 at either end. These are the only connections of the housing to the support bracket. Housing 20 does not provide any structural support for the mirror actuator 16 or mirror element 12. Housing 20 is also preferably rounded as shown to include a smooth, aerodynamic shape, and shields the support bracket, actuator and mirror element from wind and weather. In addition, peripheral rim 80 extends beyond the viewing surface of mirror element 12 such that the mirror element is recessed toward rear wall 70 of the housing a distance sufficient to reduce wind buffeting from the vehicle to which the mirror is mounted and to create an area of low turbulence on the mirror surface which not only reduces the amount of wind buffering but also prevents mist and dirt from collecting on the mirror surface to thereby improve viewing in the mirror. With fastening posts 64 projecting through the housing 20 as shown, mirror assembly 10 may

be mounted on suitable support arms extending outwardly from a vehicle, such as a truck cab, in a fixed position or for pivotal movement about the axis of posts 64 to rotate the entire assembly toward or away from the vehicle cab as desired and as specified by the support arm manufacturer. Spacer nuts and lock washers 88 may be provided on each post 64 for spacing the support arms or brackets away from the mirror housing.

Detailed Description Text (14):
As shown in FIGS. 3 and 4, when assembled in the above manner, with wires 34 connected to actuator 16 and any heating pad 14 on the rear surface of mirror element 12, actuator 16 may be controlled to position mirror 12 on support plate 24 such that it is angled either upwardly or downwardly or to either side without changing the position of the entire assembly and mirror housing 200 in its support arms or brackets on the vehicle. Moreover, the control for actuator 16 may be utilized to move the mirror element to an infinite number of intermediate positions where rotation around both vertical and horizontal axes is included. When supported as shown in FIG. 3, the center of gravity of the mirror element 12, support plate 24, releasable mounting assembly 90 and actuator 16 are positioned as close as possible to the axis defined by mounting posts 64 with respect to both the longitudinal dimension of bracket 18 and housing 20 as well as their lateral dimension (FIGS. 2 and 3). Such positioning of the center of gravity of the mirror assembly helps to reduce vibration when coupled with the increased linear and torsional stiffness of bracket 18 and the reduced weight provided by the truss or lattice work type construction.

Detailed Description Text (17):
As is shown in FIGS. 11 and 12, housing 156 is preferably injection molded from resinous plastic such as plateable grade ABS in one piece and includes a rear wail, opposing side walls and opposing end wails. As with housing 20, housing 156 can be tinted to a desired color during molding or coated with a layer of chrome. However, housing 156 also includes inwardly projecting mounting bosses 180 (FIG. 12) which are spaced apart within the housing for registry with mounting feet 166, 168 on bracket 154. Thus, when feet 166 and 168 are secured to mounting posts 180 within the housing, bracket ends 162 are positioned adjacent to but spaced from the inside surface of the opposing ends of housing 156 such that apertures 164 are in registry with apertures 175 extending through the end surfaces of the housing. Mounting fasteners 64 may then be passed through apertures 164, 175 and secured with spacer nuts and lock washers 182 to provide a common axis for mounting the mirror assembly. When positioned in this manner, widely spaced bosses 180 on the interior of housing shell 156 provide spaced fastening points which add strength and rigidity to the assembly and help reduce flexing of the housing should the housing be grasped by an operator for pivotal movement on the axis provided by mounting posts 64.

Detailed Description Text (26):
As with mirror assembly 150, housing 156 is secured to mounting feet 216, 218 of support bracket 202 by suitable screws passed therethrough into projecting bosses 180 on the inside rear surface of the housing adjacent the upper and lower ends, as shown in FIGS. 17 and 18. Thereafter, conically headed threaded screws forming fastening posts 64 are passed through apertures 214 in support bracket ends 212 to extend outwardly along a common axis through apertures in the housing 156 for engagement with suitable support arms or brackets extending from the truck or other vehicle. Spacer nuts and lock washers 182 are provided on mounting posts 64 just as in assembly 150. Apertures 253 (FIG. 17) are provided through support member 250 for access by wires 34" to the heating element/pad provided on the rear surface of mirror element 206.

CLAIMS:

9. The mirror assembly of claim 8 wherein each end of said support bracket includes a mounting stud projecting outwardly through an aperture in said housing for mounting said mirror assembly on a vehicle; said mounting studs being aligned on a common axis.

11. The mirror assembly of claim 10 wherein each end of said support bracket includes a mounting stud projecting outwardly through an aperture in said housing for mounting said mirror assembly on a vehicle; said mounting studs being aligned on a common axis.

13. The minor assembly of claim 1 wherein said support bracket includes two ends, one end being adjacent said first end wall of said housing, the other end being adjacent said second end wall of said housing; each end of said support bracket including a mounting stud projecting outwardly through an aperture in said housing for mounting said minor assembly on a vehicle; said mounting studs being aligned on a common axis.

17. The mirror assembly of claim 1 wherein said mirror mount is adjustable about at least one axis to provide movement of said mirror element within said housing to different viewing positions.

38. The mirror assembly of claim 31 wherein said support bracket includes opposing ends, each end of said support bracket including a mounting stud projecting outwardly through an aperture in said housing for mounting said mirror assembly on a vehicle; said mounting studs being aligned on a common axis.

54. The mirror assembly of claim 48 wherein said support bracket includes opposing ends, each end of said support bracket including a mounting stud projecting outwardly through an aperture in said housing for mounting said mirror assembly on a vehicle; said mounting studs being aligned on a common axis.